Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1 (currently amended) A method for interpolative coding input signals ~~at low data rates in which there is significant pitch transitivity, and wherein said signals~~ said signals ~~may have~~ decomposed into or are composed of a slowly evolving waveform and other attributes or components, the method incorporating at least one of the following steps:

(a) analysis-by-synthesis ~~vector-quantization~~ of the slowly evolving waveform such that it minimizes or reduces the effect of the non-ideal interpolation of a group of adjacent waveforms;

(b) analysis-by-synthesis quantization of the dispersion phase such that the linear shift phase attribute is reduced or eliminated from the quantization;

(c) processing a group of adjacent pitch values and weighting them to compute a weighted average in order to compute the most probable value of pitch

~~(c) locking onto the most probable pitch period of the signal using both a~~ (d) incorporating spectral ~~domain pitch search~~ and [[a]] temporal ~~domain~~ pitch ~~search~~ searches, such that the temporal search is performed at a different rate than the spectral search;

[[(d)]] (e) incorporating temporal weighting in the analysis-by-synthesis vector-quantization of the ~~signal~~ gain sequence;

~~(e) applying both high correlation and low correlation synthesis filters to a vector quantizer codebook in the analysis-by-synthesis vector-quantization of the signal gain whereby to add self correlation to the codebook vectors;~~

(f) ~~using each value of gain in the~~ quantizing adjacent values by analysis-by-synthesis vector-quantization without downsampling or interpolation of the ~~signal~~ gain values; ~~and~~

(g) incorporating switch prediction or switched filtering in the analysis-by-synthesis vector-quantization of the gain sequence;

[[(g)]] (h) using a coder in which a plurality of bits therein are allocated to the vector-quantization of the dispersion phase of the slowly evolving waveform phase from which the linear shift attribute was reduced or removed[[.]]; and

(i) pitch searching using varying boundaries of the summations used in computing the similarity or an equivalent distortion measure used for the pitch search.

2 (original) The method of claim 1 in which said signal is speech.

3 (currently amended) The method of claim 1 in which said method incorporates each of steps (a) through [[(g)]] (i).

4 (currently amended) The method of claim 1 in which in the step of analysis-by-synthesis vector-quantization of the slowly evolving waveform, distortion is reduced in the signal by obtaining the accumulated weighted distortion between ~~an original~~ a sequence of input waveforms and a sequence of quantized and interpolated waveforms.

5 (currently amended) The method of claim 1 including a system for providing at least one codebook containing magnitude and dispersion phase information for predetermined waveforms, and in which the step of analysis-by-synthesis quantization of the dispersion phase is conducted by crudely aligning the linear phase of one or the other of the input and output, then iteratively shifting said crudely aligned linear phase input or output, comparing the shifted input or output to a plurality of waveforms reconstructed from the magnitude and dispersion phase information contained in said at least one codebook, and selecting the reconstructed waveform that best matches one of the iteratively shifted inputs or outputs.

6 (currently amended) The method of claim 1 in which in the method of ~~searching the~~ temporal domain searching the instantaneous pitch period in said step ~~of locking onto the most probable pitch period of the signal,~~ comprises defining ~~a boundary for a segment of said temporal domain pitch, maximizing the best boundary and maximizing the similarity by iteratively shifting the segment, and by shrinking and expanding the segment~~ boundaries of segments of said summations used to compute similarity or an equivalent distortion measure for pitch search, selecting the best boundary such that maximizing the similarity, or minimizing the distortion, measure by iteratively shifting and by changing the length of the segments used for the summations used in the measure computations.

7 (currently amended) The method of claim 1 in which the spectral domain pitch and temporal domain pitch searches~~, in said step of locking onto the most probable pitch period of the signals,~~ are conducted ~~respectively at 100 Hz and 500 Hz~~ at different rates.

8 (original) The method of claim 1 in which the step of the temporal weighting in the analysis-by-synthesis vector-quantization of the signal gain is changed as a function of time whereby to emphasize local high energy events in the input signal.

9 (currently amended) The method of claim 1 in which selection between the high and low correlation synthesis filters in the analysis-by-synthesis vector-quantization of the signal gain is made to maximize similarity or other meaningful objective between the input target gain ~~waveform~~ vector and a ~~codebook waveform~~ reconstructed vector.

10 (currently amended) The method of claim 1 wherein each value of gain in the analysis-by-synthesis vector-quantization of the signal gain is used to obtain a plurality of shapes, each composed of a predetermined codebook having a

number of ~~values~~ entries, and comparing said shapes to [[a]] an input target vector ~~quantized codebook of shapes, each having said predetermined number of values~~ and selecting the reconstructed shape that maximizes the similarity to the input target vector.

11 (currently amended) A method for interpolative coding input signals ~~at low data rates~~ in which said signals ~~have~~ decomposed into or are composed of a slowly evolving waveform and other attributes or components, the method incorporating analysis-by-synthesis ~~vector quantization~~ of the slowly evolving waveform such that it minimizes or reduces the effect of the non-ideal interpolation of a group of adjacent waveforms.

12 (currently amended) The method of ~~claim 11~~ quantizing waveforms ~~in which distortion is reduced in the signal~~ by ~~obtaining the~~ using the accumulated ~~weighted~~ distortion between ~~an original sequence of~~ adjacent input waveforms to adjacent ~~and a sequence of~~ quantized and interpolated output waveforms, optionally using accumulated spectrally weighted distortion.

13 (currently amended) A method for interpolative coding input signals ~~at low data speeds~~ in which the signal decomposed into or composed of attributes or components one of which is a slowly evolving waveform, ~~has a slowly evolving waveform~~ which has or from which one can extract ~~and~~ a ~~linear~~ dispersion phase, the method incorporating analysis-by-synthesis quantization of the dispersion phase.

14 (currently amended) The method of claim 13 including providing at least one codebook containing magnitude and dispersion phase information for predetermined waveforms, crudely aligning the linear phase of the input, then iteratively shifting said crudely aligned linear phase input, and/or comparing the shifted input, or equivalently shifting the quantized vector, to a plurality of ~~waveforms~~ vectors reconstructed from the magnitude and dispersion phase

information contained in said at least one codebook, and selecting the reconstructed ~~waveform~~ vector that best matches the input vector or one of the iteratively shifted ~~inputs~~ input vectors.

15 (original) The method of claim 14 in which the average global distortion measure for a particular vector set M is:

$$\frac{1}{M}\sum_{m=\{Data\ Vectors\}}\frac{1}{K_m}\sum_{k=1}^{K_m} w_{kk,m}\left|r(k)_m - e^{j\hat{\varphi}(k)_m}\left|\hat{r}(k)\right|_m\right|^2$$

and including the step of minimizing the global distortion thereof by using the following formula for the k-th harmonic's phase for the j-th cluster:

$$\hat{\varphi}(k)_{jth-cluster} = \operatorname{atan}\left[\frac{\sum_{m=\{jth-cluster\}}\frac{1}{K_m} w_{kk,m}\left|r(k)_m\right|\sin(\varphi(k)_m)}{\sum_{m=\{jth-cluster\}}\frac{1}{K_m} w_{kk,m}\left|r(k)_m\right|\cos(\varphi(k)_m)}\right]$$

16 (original) The method of claim 14 in which the average global distortion measure for a particular vector set M is:

$$\frac{1}{M}\sum_{m=\{Data\ Vectors\}}\frac{1}{K_m}\sum_{k=1}^{K_m} w_{kk,m}\left|r(k)_m - e^{j\hat{\varphi}(k)_m}\left|\hat{r}(k)\right|_m\right|^2$$

and including the step of minimizing the global distortion thereof by using the following formula for the k-th harmonic's phase for the j-th cluster:

$$\hat{\varphi}(k)_{j^{th}-cluster} = \operatorname{atan}\left[\frac{\sum_{m=\{j^{th}-cluster\}}\frac{1}{K_m}w_{kk,m}\left|\hat{r}(k)_m\right|\left|r(k)_m\right|\sin(\varphi(k)_m)}{\sum_{m=\{j^{th}-cluster\}}\frac{1}{K_m}w_{kk,m}\left|\hat{r}(k)_m\right|\left|r(k)_m\right|\cos(\varphi(k)_m)}\right]$$

17 (currently amended) A method for interpolative coding input signals ~~at low data rates~~, comprising using spectral and temporal pitch searches, computing a number of adjacent pitch values and optionally some weight associated with their probability, and then computing ~~locking onto~~ the most probable pitch ~~period of the signal using both a spectral domain pitch search and a temporal domain pitch search~~ value by computing the weighted average pitch value using the above said weight.

18 (currently amended) The method of claim 17 in which in the method of searching the temporal domain pitch comprises defining a boundary for a segment ~~of said temporal domain pitch~~ used for the summations in the computed measure used for the pitch search, selecting the ~~length of the~~ boundaries of the segment that maximize the similarity, or minimize the distortion measure, used

for the pitch search, by iteratively shifting and expanding the segment and by shifting the segment.

19 (original) The method of claim 18 in which the method of searching the temporal domain pitch is in accordance with the formula:

$$P(n_i) = \underset{\tau, N_1, N_2}{\arg\max} \{ \rho(n_i, \tau, N_1, N_2) \} =$$

$$\underset{\tau, N_1, N_2}{\arg\max} \left\{ \frac{\sum_{n=n_i-N_1\Delta}^{n_i+\tau+N_2\Delta} s_w(n) s_w(n-\tau)}{\sqrt{\sum_{n=n_i-N_1\Delta}^{n_i+\tau+N_2\Delta} s_w(n) s_w(n)} \sqrt{\sum_{n=n_i-N_1\Delta}^{n_i+\tau+N_2\Delta} s_w(n-\tau) s_w(n-\tau)}} \right\}$$

where t is the shift in the segment, D is some incremental segment used in the summations for computational simplicity, and Nj is a number calculated for the codes.

20 (currently amended) ~~The~~ A method ~~of claim 19 including the step of obtaining the~~ for using a weighted average to compute one pitch value out of a set of pitch values, in accordance with the formula:

$$\cancel{P_{mean} = \sum_{i=1}^{5} \rho(n_i) P(n_i) / \sum_{i=1}^{5} \rho(n_i)}$$

$$P_{mean} = \sum_{i=1}^{M} \rho(n_i) P(n_i) / \sum_{i=1}^{M} \rho(n_i)$$

where M is the number of averaged pitch values an d $\rho(n_i)$ is the normalized correlation for $P(n_i)$.

21 (original) The method of claim 19 in which the spectral domain pitch and temporal domain pitch searches in said step of locking onto the most probable pitch period of the signals are conducted respectively at 100 Hz and 500 Hz.

22 (currently amended) A method and a system for ~~interpolative coding input signals at low data speeds, comprising incorporating temporal weighting in the~~ vector quantization of the signal gain sequence using analysis-by-synthesis ~~vector-quantization of the signal gain~~, optionally using temporal weighting, and optionally using a switch predictive synthesis filter or predictor.

23 (original) The method of claim 22 in which the temporal weighting is changed as a function of time whereby to emphasize local high energy events in the input signal.

24 (currently amended) [[A]] The method ~~for interpolative coding input signals at low data speeds~~ of claim 22, comprising applying synthesis filter or predictor, which introduces selected ~~both~~ high correlation or ~~and~~ low correlation ~~synthesis filters~~ to a vector quantizer codebook in the analysis-by-synthesis vector-quantization of the signal gain sequence whereby to add selected self correlation to the codebook vectors.

25 (currently amended) The method of claim 24 in which selection between the high and low correlation synthesis filters or predictor is made to maximize similarity or other relevant measure between the signal ~~waveform~~ vector and a ~~codebook waveform~~ reconstructed vector.

26 (currently amended) [[A]] The method ~~for interpolative coding input signals at low data speeds~~ of claim 22, comprising using each value of gain index in the analysis-by-synthesis vector-quantization of the signal gain.

27 (currently amended) The method of claim ~~26~~ 22 wherein each value of gain index is used to ~~obtain~~ select from a plurality of shapes and associated predictors or filters, each of which is used to generate an output shape vector ~~composed of a predetermined number of values~~, and comparing ~~said shapes~~ the output shape vector to ~~a vector quantized codebook of shapes, each having said predetermined number of values~~ an input shape vector.

28 (currently amended) The method of claim 27 in which said set has predetermined number of values ~~is~~ in the range of [[2]] 1 to 50.

29 (currently amended) The method of claim ~~28~~ 33 in which said set has predetermined number of values ~~is~~ in the range of [[5]] 1 to ~~20~~ 50.

30 (currently amended) (currently amended)A method for interpolative coding input signals ~~at low data rates~~ in which said signals ~~have~~ decomposed into or are composed of a slowly evolving waveform and other attributes or components, comprising using a coder in which a plurality of bits therein are allocated to the vector-quantization of the dispersion phase of the slowly evolving waveform phase from which the linear shift attribute was reduced or removed.

31 (currently amended) The method of claim 30 in which ~~4 bits are~~ at least one bit is allocated to the ~~slowly evolving waveform phase in the coder~~ dispersion phase.

32(New) A method for simplifying accumulated distortion between a set of adjacent input vectors, r_{m2} to a set of quantized and interpolated vectors

$\hat{\mathbf{r}}$

$$D_{wI}(\hat{\mathbf{r}}_M, \{\mathbf{r}_m\}_{m=1}^{M+L-1}) = \begin{bmatrix} \sum_{m=1}^{M} [\mathbf{r}_m - \tilde{\mathbf{r}}_m]^H \mathbf{W}_m [\mathbf{r}_m - \tilde{\mathbf{r}}_m] \\ + \sum_{m=M+1}^{M+L-1} [1-\alpha(t_m)]^2 [\mathbf{r}_m - \tilde{\mathbf{r}}_M]^H \mathbf{W}_m [\mathbf{r}_m - \tilde{\mathbf{r}}_M] \end{bmatrix}$$

by an equivalent simple distortion between only one input and one optimized output vector:

$$D_w(\hat{\mathbf{r}}_M, \mathbf{r}_{M,opt}) = (\hat{\mathbf{r}}_M - \mathbf{r}_{M,opt})^H \mathbf{W}_{M,opt} (\hat{\mathbf{r}}_M - \mathbf{r}_{M,opt})$$

where computing optimal vector $r_{M,opt}$ by:

$$\mathbf{r}_{M,opt} = \mathbf{W}_{M,opt}^{-1} \begin{bmatrix} \sum_{m=1}^{M} \alpha(t_m) \mathbf{W}_m [\mathbf{r}_m - [1-\alpha(t_m)] \hat{\mathbf{r}}_0] \\ + \sum_{m=M+1}^{M+L-1} [1-\alpha(t_m)]^2 \mathbf{W}_m \mathbf{r}_m \end{bmatrix}$$

and the respective weighting matrix $W_{M,opt}$ is given by:

$$\mathbf{W}_{M,opt} = \sum_{m=1}^{M} \alpha(t_m)^2 \mathbf{W}_m + \sum_{m=M+1}^{M+L-1} [1-\alpha(t_m)]^2 \mathbf{W}_m$$

33 (New) A method and a system for quantizing waveform using the simplification method of claim 32 such that the respective quantized vector $\hat{\mathbf{r}}_M$ is given by:

$$\hat{\mathbf{r}}_M = \underset{\mathbf{r}'_i}{\operatorname{argmin}} \left\{ (\mathbf{r}'_i - \mathbf{r}_{M,opt})^H \mathbf{W}_{M,opt} (\mathbf{r}'_i - \mathbf{r}_{M,opt}) \right\}$$

34 (New) The method of claim 17 in which in the method using the normalized autocorrelations obtained for each pitch value, or some function of the autocorrelation, as its associated probability weight used to compute the weighted average pitch value.